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ABSTRACT

The report was prepared for the National Highway Traffic Safety Administration (NHTSA) of the U.S. Department of Transportation. The report briefly reviews the appropriate literature, then describes the one-year program which involved planning and organization of a Highway Collision Investigation Training Program, preparing a course syllabus, and conducting three training sessions of three weeks each for members of multidisciplinary collision investigation teams and others selected by NHTSA. A four-page bibliography is included. One-half of the document consists of five appendixes: the class schedule, a summary of basic elements and features of the training facilities, instructions for operating the selective breaking system vehicle, lists of instruction staff and attendees, and students' class critique. (Author/JR)

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HIGHWAY COLLISION INVESTIGATION TRAINING PROGRAM

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Cornell Aeronautical Laboratory, Inc.
4455 Genesee Street
Buffalo, New York 14221

Contract No. FH-11-7572
February 1972
Final Report

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
WASHINGTON, D.C. 20590

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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16. Abstract

This report was prepared for the National Highway Traffic Safety Administration (NHTSA) of the U. S. Department of Transportation. The program described in this report involved planning and organization of a Highway Collision Investigation Training, Program, preparing a course syllabus, and conducting three training sessions of three weeks each for members of multi-disciplinary collision investigation teams and others selected by NHTSA. The program duration was one year.

For training course syllabus, see VJ-2980-V1, dated June 1971.

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FOREWORD

This report was prepared for the National Highway Traffic Safety Administration (NHTSA) of the U. S. Department of Transportation under Contract FH-11-7572. The program described in this report involved planning and organization of a Highway Collision Investigation Training Program, preparing a course syllabus, and conducting three training sessions of three weeks each for members of multi-disciplinary collision investigation teams and others selected by NHTSA. The program duration was one year.

As part of the contract requirements, a Training Course Syllabus was prepared, titled: "Program of Instruction for Highway Collision Investigation Training Program," CAL Report No. VJ-2980-V1, dated June 1971. A volume of course material was provided for all attendees, which included reports, accident investigation articles, procedures, accident equipment lists, worksheets, accident investigation aids, and a Proceedings of the Collision Investigation Methodology Symposium.

This report has been reviewed and is approved.

Edwin A. Kidd

Edwin A. Kidd, Head
Transportation Research Department

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INTRODUCTION

There is a clear need for an adequate volume of motor vehicle and highway research data for use in determining corrective measures, in promulgating standards and in measuring benefits accruing from specific programs. To meet this need, the National Highway Traffic Safety Administration has established a number of multi-disciplinary collision investigation teams throughout the country. These teams have evolved from the Medical-Engineering teams originally created by NHTSA.

In 1969, a seminar sponsored by NHTSA was conducted at UCLA[1, 2] for the Medical-Engineering teams. This initial training program was oriented toward the collection of data concerning injury causation and human tolerance to trauma.

With the growth of the multi-disciplinary team program, it was recognized that there was a need for a training program that would guide new teams and team members in planning and organizing their operations, in meeting minimum investigative procedures and data requirements, and in maintaining reasonable uniformity in the collection of basic data without limiting the freedom and initiative of the researcher to explore new areas. The training program described in this report, and in a Syllabus published in a separate volume, was developed to meet this need.

The major objective of the training program was to prepare the course syllabus and to conduct three training sessions for multi-disciplinary team members. In addition, training material used by lecturers was prepared in loose-leaf form and submitted to the sponsor. The present report provides a general description of the program.

REVIEW OF LITERATURE

The first study task involved a review of available literature on highway collision investigation methodology and training. Specifically mentioned for review were the reports listed as 1 through 7 in the Bibliography. These reports, and a number of others that are deemed to have some utility for accident investigation personnel, are discussed in this section to point out those areas where they may be useful to investigators. In addition to the reports discussed here, a bibliography of other reports was prepared for this program. Some of these are directly applicable to collision investigation while others are of peripheral interest only. All, however, contain information which may be useful in certain investigative areas, and accident investigators should be aware of their existence.

One of the first accident investigations manuals[3] was produced by J. Stannard Baker at Northwestern in 1953. Although designed primarily for police use, and consequently not attempting to describe investigation in the same depth as that of multi-disciplinary teams, this is still one of the best general manuals available.

In general, most reports or manuals on accident investigation describe the process of accident investigation. Perhaps because most early investigation was done by police, little has been written about the organization and development of an accident investigation program. One study which does describe the organization and operation of a team study was written by Tharp and Garrett at Cornell Aeronautical Laboratory, Inc.[4] This report provides information on such subjects as securing cooperation of various agencies, personnel employed, training, equipment, alerting methods, on-scene investigation, data storage and retrieval and many other topics, and should be particularly useful as a general guide for those initiating new investigation programs.

Also useful in this regard is the volume, "Proceedings of the Collision Investigation Methodology Symposium."[5] The symposium was conducted at Airlie House, Warrenton, Virginia in 1969 by Cornell Aeronautical Laboratory, Inc. for the National Highway Traffic Safety Administration. Appearing at this Symposium were most of the major researchers in the highway accident field. The format provided to speakers required a description of the planning, organization, personnel, training, alerting system, etc. of his particular study. Thus, new investigation personnel can obtain a cross-section of approaches used by a number of experienced investigators.

At the University of California at Los Angeles, Siegel conducted a Medical-Engineering Seminar[1, 2] for the National Highway Traffic Safety Administration in 1969. At that time, the emphasis in the Federal program was on the Medical-Engineering team and injury-vehicle relationships rather than the multi-disciplinary team and the broader in-depth aspects of accident investigation. The program, therefore, was primarily concerned with human tolerance and was generally oriented toward injury causation with limited emphasis on accident causation and on-scene investigation.

A report on research to improve the process of accident investigation[6] was prepared by Keryeski and Garrett at the Cornell Aeronautical Laboratory, Inc. in 1968. This report, in three volumes, examined the state of the art of accident investigation and then explored methods and technology to improve the process. Many of the programs, methods and technological advances recommended for use have been adopted in accident investigation or in related research programs. Among these are: methods of preserving and documenting collision scene evidence, use of vehicle diagnostic centers, aerial photography, camera boom, vehicle evaluation, interviewing, etc.

A report by Garrett and Tharp[7] conducted at the Cornell Aeronautical Laboratory, Inc. for the National Cooperative Highway Research Program provides broad background information on the state of the art of accident investigation, recommends and describes a multi-level approach and discusses a number of specific topics of interest to investigators. This report should be of particular interest to state officials organizing a multi-disciplinary team operation as part of the state's highway safety program.

Another group of reports which is concerned specifically with accident investigation appears in the Bibliography (9 to 15). For the most part, these reports or manuals emphasize one or two aspects of investigation (brakes or tires, for example) more than others. Also, the audience - and thus the objective - that the book is designed for may be rather specialized, e.g., attorneys.

The remaining reports listed in the Bibliography provide a variety of information that is of interest to investigators. The topics include human tolerance to impact forces, findings of many accident and injury causation studies, human factors, damage and injury indices, test crashes, and many others. The listing is by no means exhaustive, but includes most major reports and a number of lesser known ones that may be useful in accident investigation, reconstruction and analysis.

Standard manuals and texts used in various professions are not included since it is assumed that appropriate team members will have these volumes in their library. Examples of such reference works are: "Manual on Uniform Traffic Control Devices for Streets and Highways," "Manual on Classification of Motor Vehicle Traffic Accidents." The "Vehicle and Traffic Law" of the state in which investigators are operating, the annual "Motor Vehicle Identification Manual" produced by the National Automobile Theft Bureau or the Federal Highway and Motor Vehicle Standards and Programs of the U. S. Department of Transportation.

PLANNING AND ORGANIZATION

Information obtained from the Literature Review as well as CAL experience with other accident investigation training programs suggested that previous approaches were too limited for a multi-disciplinary collision investigation training program. Earlier training programs generally were designed for law enforcement personnel, or had rather circumscribed objectives: training for the study of injury causation only, or for the study of accident causation only. In most programs, too, the amount of time devoted to field training was extremely limited, although the on-scene collection and recording of data is the essential element in collision investigation.

Because of the diversity of backgrounds and experience among trainees, it was difficult to plan a program that was adaptable to all. It was known that the trainees would include both experienced and inexperienced investigators (the actual range of experience was from one week to more than twenty years), and that some would later conduct investigations while others would hold administrative positions with teams or with government organizations throughout the world.

In planning the training program, emphasis was placed on practical investigation methods, procedures, equipment and accident reconstruction techniques, and a reasonable balance between classroom instruction and field practice and instruction was sought (see Schedule, Appendix 1). Although background information concerning accident investigation was provided, it was assumed that the trainees would be well versed in the theory and practices of their various professions and no effort was made to review basic subject matter. This would have been impossible in any event, given the limited time available and the number of subject areas covered. Later, some trainees expressed a desire for such a review, but this is still regarded as impractical without a major revision in the scope and objectives of the training program.

While prior knowledge in a profession was assumed, no assumption of prior knowledge was made with respect to the actual methods and equipment used in data collection. Thus, in photography, a brief basic review of equipment, methods and problems was conducted, followed by a detailed program to illustrate photographic requirements in investigation. This was followed by practice sessions and, finally, a critique of trainee photography was held. The response of the trainees was typical of that observed in other subject areas: experienced investigation photographers believed that they did not need this detailed approach while novices felt that it was both important and useful to them.

Instruction Staff

Training was conducted by members of the CAL staff augmented by visiting lecturers from other teams and universities. The Automobile Manufacturers Association, Inc. and the National Highway Traffic Safety Administration also provided the services of key personnel. The names of these lecturers were listed earlier and represent a number of the disciplines utilized in highway safety and related research.

Each lecturer was provided an outline of the subject area he was expected to cover. He was also asked to emphasize critical areas and to point out problems which his experience suggested would be useful. Some revision of the original schedule was made after the first session because it was apparent that additional work was needed in several subject areas. Thus, for example, additional instruction and practice in rating injury severity was provided in later sessions when it became clear that trainees were having difficulty in rating injury.

In addition to instruction in routine accident investigation subjects, examples of non-routine in-depth studies were provided. As an example, members of the CAL staff who had conducted metallurgical studies of vehicle components to determine cause of failure lectured the classes on methods and findings.

Facilities and Equipment

The availability of appropriate facilities and equipment is important in the collision investigation training program not only because of their actual use in the training, but because trainees can be exposed to other aspects of highway research and to the personnel conducting that research. (A description and photographs of CAL research facilities and equipment used in the training program is provided in Appendix 2.) All trainees in the CAL program observed at least one test crash, and examined the impact sled and other test equipment. The presence of personnel engaged in other highway safety research at CAL made them available to describe and illustrate pertinent research related to investigation activities.

Mathematical simulation and its use in accident reconstruction provided useful vehicle and human kinematics data for students. Crashworthiness studies at CAL made it possible to illustrate clearly the link between the investigation and study of vehicles damaged on the highway and design modifications made to improve the vehicle. Crash tests also provided a ready source of damaged vehicles for photography and other training purposes. (Figure 1)

Figure 1

The test track facility also provided different types of roads for the staging of accidents for trainee investigation. The skid pad was used to demonstrate vehicle handling (Figure 2), to demonstrate tests of stopping distances (Figure 3) and to place various types of tire marks for study. In this regard, too, a car in which any one or any combination of brakes could be "failed" was used to demonstrate vehicle behavior when certain brake failures occurred, as well as the type of evidence left on the roadway (see Appendix 3). This type of demonstration also provided a source of tire marks for measurement and interpretation exercises by trainees (Figure 4).

Figure 2

Figure 3

Figure 4

Classroom

Standard classroom facilities are adequate for much of the instruction required. However, because of the extensive use of visual aids - slides, motion pictures and Vu-graphs - CAL kept projection equipment available throughout each session. Equipment kept available included:

One 16 mm sound projector
Two 35 mm slide projectors
One 3"x4" slide projector
Two projection screens
Vu-graph projector

Two screens and slide projectors were used in order to illustrate the accident scene and vehicle damage at the same time or to simultaneously project a sketch of occupant injuries and the component that caused them. This technique facilitated the instruction process and allowed maximum flexibility in reconstructing an accident in the class.

Each student was provided with approximately eight or nine square feet of table space because many of the exercises required room for laying out several documents at a time. Also, training program material was bound in a four inch thick loose leaf volume and was used extensively. (Training material was submitted to the sponsor as a separate document.)

It was planned to use the CAL auditorium (Figure 5) for training classes because of the large area available and because of the presence of an excellent, and permanent, loudspeaker system and projection equipment. However, the decision to conduct this session was made by the sponsor shortly before it was held, and prior committments for the facility made it unavailable for many classes. A large conference room was used instead and, while adequate, it was not as good as the auditorium. The latter facility was used for the next two sessions with excellent results. An equivalent facility is strongly recommended for future training programs of this type.

A brief description of the CAL auditorium facility is as follows:

Normal capacity	110
Maximum capacity (advance notice needed)	250
Motion picture screen, permanent	
Motion picture projector, 16 mm, optical and magnetic sound.	
Slide projector (A0) for 3-1/4 x 4" slides	
Slide projector for 35 mm and 2-1/4 x 2-1/4 slides	
Vu-Graph	
Sliding blackboards	
Speakers' Table and Podium	
PA System	

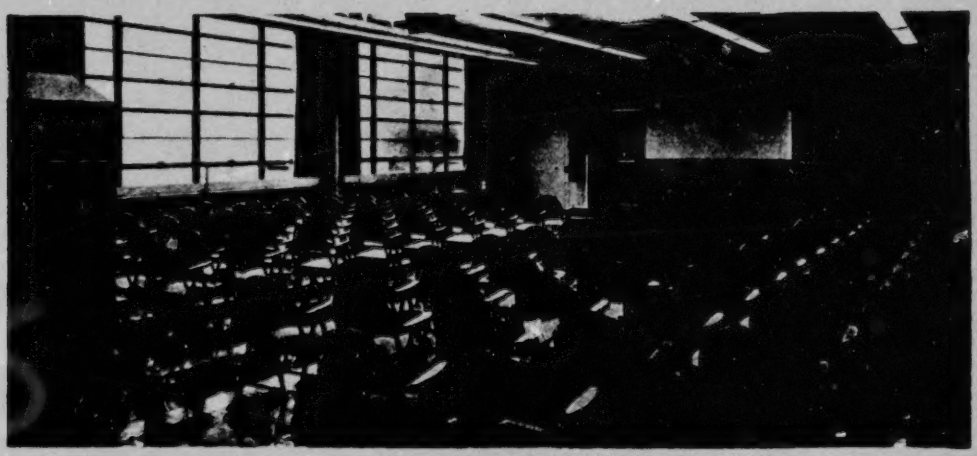

Figure 5

Student Critique

In the three training sessions, students were asked to comment on each class with respect to various aspects of the course, the subject discussed, the lecturer, etc. using a critique sheet (Appendix V) as a guide. Since there are too many comments to include them all, a reasonable way of presenting them seemed to be the inclusion of all comments from one entire session. All comments from the third training session, therefore, are presented in Appendix V. These are deemed fairly representative of comments from the other sessions, as well.

TRAINING SESSION I

The first training session was conducted during the period from 30 November to 18 December 1970. A total of 19 instructors presented lectures at this session; 8 of them from organizations other than CAL. Attending the class were 21 individuals who participated for periods ranging from two days to the full three weeks. (Attendees and instructors are listed in Appendix 3.)

Participating in this training session were a number of accident investigators from the North Atlantic Treaty Organization (NATO) nations. These personnel participated as part of an effort to broaden the cooperative activities of the U. S. and other member countries to include productive peacetime activities in addition to military defense. Member nations in this organization are: Belgium, Canada, Denmark, France, West Germany, Great Britain, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Turkey, and the United States. Four of these countries, Belgium, Canada, Denmark and France participated in the program. Two members of the Volvo organization from Sweden also attended.

Previous training and experience of the attendees varied widely. As a group, however, those attending the first training class represented the most experienced accident investigators to participate in the three sessions conducted during the contract year.

For reasons mentioned in the Planning and Organization section, the CAL auditorium could be obtained for only part of the first session. The room obtained in its stead while adequate in size, was not considered completely suitable because it was necessary to move projectors and screens periodically to accommodate the requirements of various speakers and, because of its location, it was difficult at times to provide convenient transportation to other facilities.

In planning the syllabus, a modular approach was attempted, i.e., provision was made during the second week to divide attendees into three groups so that they could spend two days attending classes in their area of speciality: Human Factors, Environment or Vehicle. Attendees were then asked to record their choice of subject in order that three groups could be selected. It developed that most people desired to attend the vehicle session and, furthermore, most expressed a desire to spend some time in two or in all three specialty groups. Since most of the class members were experienced investigators an effort was made to accommodate their desires after discussion with sponsor representatives. Each individual then was assigned to his first choice subject and allowed to attend classes in other specialty areas on a pre-arranged basis. Even so, this was not a satisfactory procedure because the students, experienced though most of them were, lost the advantage of presentation continuity. Instructors, too, had difficulty because it became necessary to summarize material presented previously in an effort to provide some continuity in data presentation for newcomers. In the two later sessions, in response to sponsor suggestions, the modular approach was abandoned and the available time divided between the three topic areas.

A related problem in maintaining continuity occurred to some extent in all three training sessions because many trainees attended for short periods of time. A few of those who attended only the first week complained that they had received basic training without sufficient detail and practice. They were right, this was scheduled for later sessions which they did not attend. A few who attended the second or third week complained that they were asked to do tasks without basic training. They, too, were right since they had not attended the initial classes.

The diverse backgrounds of the trainees also posed a problem at times. As an example, several hours of class time was devoted to a basic outline of human anatomy and injury mechanisms. This was thought to be excellent by most of the engineers and non-medical personnel. Most physicians, of course, were not interested in this aspect of the course at all.

The problems discussed are all basically associated with the variety of professional disciplines and the range of experience of the trainees, and with the length of time that can be expended by each individual in training. These factors cannot be changed, given the requirements of the multi-disciplinary teams. In retrospect, therefore, it appears that the modular approach is probably best after the first week of basic training. That is, to provide all trainees with the same basic training and then separate them according to their individual discipline and interests for the advanced segments of the training.

A team of photographers from the United States Information Agency requested, and were granted, permission by the sponsor to produce a motion picture of many of the training classes during the first session. Although the purpose of the film may have been quite good, this activity was extremely disruptive for several days. There were many complaints from attendees and accommodating these personnel placed a heavy strain on CAL personnel involved in the training program.

TRAINING SESSION II

The second training session was conducted during the period from 8 February to 26 February, 1971. A total of 25 persons attended this session and the period of attendance varied from two days to the full three weeks. Once again, the investigation experience of those attending varied from none to several years. There were 23 instructors participating in this session, 9 of whom were from organizations other than CAL.

A number of changes were made in the lectures to strengthen areas where it was thought additional emphasis was needed. A separate two hour lecture on truck examination and evaluation was added instead of including this subject in the general vehicle lecture. Two hours were added to the lecture on the use of the Medical Index, and one hour to the lecture on post-mortem study in order to more adequately discuss the use of the Armed Forces Institute of Pathology (AFIP) report form. Another hour was added to the review of the Vehicle Deformation Index (VDI), as well. These are all topic areas where it was evident that the various team members participating in the first session did not collect or report data uniformly, or where it was clear that insufficient emphasis was placed by various teams.

A simulated side impact crash with appropriate tire marks, debris and other physical evidence was arranged on a road within the CAL facility for investigation by participants. The vehicles used were test vehicles that had impacted one another. All participants conducted a complete investigation of this "accident". Trainees were divided into groups each with an instructor to examine and measure appropriate scene and vehicle interior and exterior evidence. A vehicle report form was completed, field sketches of the scene were made and the collision was completely reconstructed by the students. A similar single vehicle impact with a pole type barrier had been conducted in the first training session.

The investigation of the simulated accident worked exceptionally well in all of the training sessions. In using this approach, assignment of specific tasks to each group, and to each member of the group, is important. Groups must then be rotated in order that each individual is given an opportunity to conduct all aspects of a complete on-scene investigation.

One change was made in the third session as a result of using test crash vehicles. Because dummy impacts to the interior were not sufficiently realistic, an actual two car accident, described in the next section, was recreated.

Two participants worked with the CAL team for three hours each evening, monitoring police calls and going to the scene of accidents. A number of these individuals participated in actual on-scene investigations and completed portions of the case. Some of these data later were used in class discussions of specific subject areas, lending considerable interest to these sessions.

With only two participants working with the CAL team, there were no problems at the scene and it was a real-world experience for them. Comments, particularly from newer team members who had little or no exposure to investigation, were highly favorable.

TRAINING SESSION III

The third and last session of the training program was conducted from 12 April to 30 April, 1971. Attending for one or more weeks were 29 persons. An instruction staff of 26 persons contributed to this session.

In previous sessions some participants attended for as short a period as one or two days to a week and they selected the period of attendance within the session. This proved to be disruptive since they did not know what had been done, and often wanted lengthy discussions of topics that had already been covered. A few even suggested the need for more basic preparation material - which had been presented in sessions prior to their attendance. For this session, the sponsor agreed that participants had to remain at least a week and most attended for two to three weeks.

It was planned, originally, that one or two test crashes would be investigated by trainees as well as actual accidents that were reconstructed on the CAL test facility. Use and examination of test crash vehicles indicated that test circumstances and evidence did not provide sufficiently realistic data for training purposes. Imprints or damage left on the vehicle interior by the dummy generally were not realistic either.

Although a number of test crashes were conducted during each training session, only one test was used for investigation purposes in each session. However, trainees were allowed to view crash tests and were asked to give estimates of the speed of the moving car prior to impact. They were then allowed to examine vehicle damage and re-estimate impact speed if they wished. This graphically illustrated the difficulty in estimating the speed of a moving vehicle (suggesting some of the problems with respect to witness reliability, as well).

One test crash was reconstructed at CAL for training purposes in this session. It involved a single car collision with a pole. One actual highway accident in which a fatality occurred was reconstructed for analysis as well.

The fatal accident was laid out on a road on the CAL test track facility precisely as it had occurred. Tire marks, debris, final rest positions, etc. were as close to the appearance of the original accident as it was possible to stage. (Figures 6, 7, 8) Thus, when trainees examined the scene and vehicles the physical evidence both inside and outside the vehicle was real. It was possible for them to reconstruct the accident and to observe the actual transfers and imprints made by human skin, teeth, clothing, hair and other materials.

Figure 6

Aside from the realism mentioned, the use of actual accident vehicles permits the use of slides taken at the original scene for class discussion immediately after the investigation session. Thus, a complete review and discussion of the case including injury and interview data can be accomplished at once. CAL also staged the appropriate interviews in a number of cases using trainees as interviewers and CAL personnel familiar with the case as the interviewee. This approach worked quite well and, again, the results could be compared with the original interview immediately to point out subject areas where the trainee might have obtained additional information through the use of proper interviewing techniques.

CONCLUSIONS AND RECOMMENDATIONS

A minimum training period of two weeks is recommended. Three weeks is believed to be the optimum period to provide adequate field practice for new and inexperienced investigators.

Field exercises and practice in actual investigation tasks are key elements in this type of program. Trainees bring their professional knowledge and experience but need guidance and practice in its application to accident investigation.

Providing training for personnel with diverse professional backgrounds is a difficult task at best. Grouping experienced and inexperienced personnel as well as administrative and investigation personnel in the same classes compounded the problem because of the varied interests and needs of the individuals. It would be desirable to limit attendance at the training sessions to new or relatively inexperienced accident investigation personnel. Shorter seminars for experienced investigators and administrative personnel could then be designed to meet their needs.

A seminar of perhaps one week to be conducted one year after completion of a training session was recommended by a number of the experienced investigators attending the first training session. A seminar of this type is recommended to provide some feedback on the effectiveness of training and to incorporate suggested modifications into the program.

Essential to the success of a multi-disciplinary collision investigation training program are adequate facilities of the type described in this report. These facilities and equipment are important because the conduct of field exercises is a critical aspect of this training program. Appropriate research facilities also assure exposure to a broad spectrum of related research and to the personnel conducting the studies.

The organization providing the training should provide a large part of the instruction staff. It is extremely important, however, that instructors from other organizations be used in order to provide a broad range of experience and viewpoints to trainees.

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APPENDIX I

CLASS SCHEDULE

CLASS SCHEDULE

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
9 AM	Introduction Orientation (1-1)	Collection, Preservation and Interpretation of On-Scene Evidence (2-1)	Interviewing as Communication (3-1)	Human Anatomy, Crash Injuries and Forensic Identification Techniques (4-1)	Human Anatomy, Crash Injuries and Forensic Identification Techniques (5-1)
10 AM	CAL Highway Research Facilities (1-2)	B R E A K			
10:15 AM	11:00 AM BREAK	Cont. (2-2)	Cont. (3-2)	Cont. (4-2)	Cont. (5-2)
11:15 AM	The Highway Transportation System (1-3)	Environmental Factors in Accidents (2-3)	Introduction to Interviewing Methods (3-3)	Cont. (4-3)	Cont. (5-3)
12:15 PM	L U N C H				
1:15 PM	Accident Investigation - State of the Art (1-4)	Cont. (2-4)	The Psychological Autopsy (3-4)	Injury Producing Mechanisms and Injury Scaling (AMA Index) (4-4)	Elements of a Completed Case Report (5-4)
2:15 PM	Methods of Field Data Collection and Relations with Other Agencies (1-5)	Descriptions and Functions of Subsystem Components of Modern Passenger Cars (2-5)	Cont. (3-5)	Cont. (4-5)	Introduction to Vehicle Damage Index (5-5)
3:15 PM			B R E A K		
3:30 PM	Multi-Disciplinary Team Investigations (1-6)	Cont. (2-6)	Cont. (3-6)	Cont. (4-6)	Introduction to Accident Reconstruction (5-6)
4:30 PM	NHTSA Approach to Accident Investigation (1-7)	Program Matrix for Highway Safety (2-7)	Cont. (3-7)	Cont. (4-7)	Cont. (5-7)

Class Schedule

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
9:00 AM	Photography in Motor Vehicle Accident Investigation (6-1)	Evaluation of Pre Crash Truck Factors in Accidents (7-1)	Completing the GM Collision Performance and Injury Report Form (8-1)	Speed Estimation, Part I (9-1)	Pedestrian Kinematics (10-1)
10:00 AM	B R E A K				
10:15 AM	Cont. (6-2)	Cont. (7-2)	Cont. (8-2)	Cont. (9-2)	Measuring and Recording Skid Marks (10-2)
11:15 AM	Cont. (Field Exercise) (6-3)	Cont. (7-3)	Cont. (8-3)	Vehicle Damage Index (9-3)	Cont. (10-3)
12:15 PM	L U N C H				
1:15 PM	Cont. (6-4)	Investigation and Analysis of Pre-Crash Vehicle Factors in Traffic Accidents (7-4)	Cont., Field Exercise, (8-4)	Field Exercise, Skid and Brake Tests, Measurements (9-4)	Measurement Techniques (10-4)
2:15 PM	Field Equipment (6-5)	Cont. (7-5)	Cont. (8-5)	Cont. (9-5)	Occupant Kinematics (10-5)
3:15 PM	B R E A K				
3:30 PM	Postmortem Studies and AFIP Form (6-6)	Cont. (7-6)	Cont. (8-6)	Field Exercise, Accident Investigation (9-6)	Field Exercise, Accident Investigation (10-6)
4:30 PM	Cont. (6-7)	Cont. (7-7)	Cont. (8-7)	Cont. (9-7)	Cont. (10-7)

Class Schedule, cont.

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
9:00 AM	Vehicle Damage Index (11-1)	Introduction to Vehicle Handling (12-1)	Experimental Crashes (13-1)	Exercise in Interviewing Techniques (14-1)	Reconstruction and Completion of Student Accident Investigation Reports (15-1)
10:00 AM	B R E A K				
10:15 AM	Use of Cue Card in Interviewing (11-2)	Vehicle Handling and Component Degradation (12-2)	Accident Reconstruction (13-2)	Cont. (14-2)	Cont. (15-2)
11:15 AM	Cont. (11-3)	Accident Reconstruction (12-3)	Components of Completed Case, Cont. (13-3)	Speed Estimation, Part II and Part III (14-3)	Cont. (15-3)
12:15 PM	L U N C H				
1:15 PM	Development of New Accident Investigative Aid (11-4)	Exercise in Interviewing Techniques (12-4)	Critique of Student Photos (13-4)	Cont. (14-4)	Review of Course Objectives (15-4)
2:15 PM	Team Interactions (11-5)	Cont., (12-5)	Cont. (13-5)	Cont., Field Exercise (14-5)	Student Critique (15-5)
3:15 PM	B R E A K				
3:30 PM	Metallurgy as an Investigative Aid (11-6)	Cont. (12-6)	Field Exercise, Accident Investigation (13-6)	Field Exercise, Accident Investigation (14-6)	Course Conclusion Comments Award of Certificates (15-6)
4:30 PM	Occupant Kinematics (11-7)	Vehicle Damage Index (12-7)	Cont. (13-7)	Cont. (14-7)	Course Conclusion Comments Award of Certificates (15-7)

APPENDIX II

FACILITIES

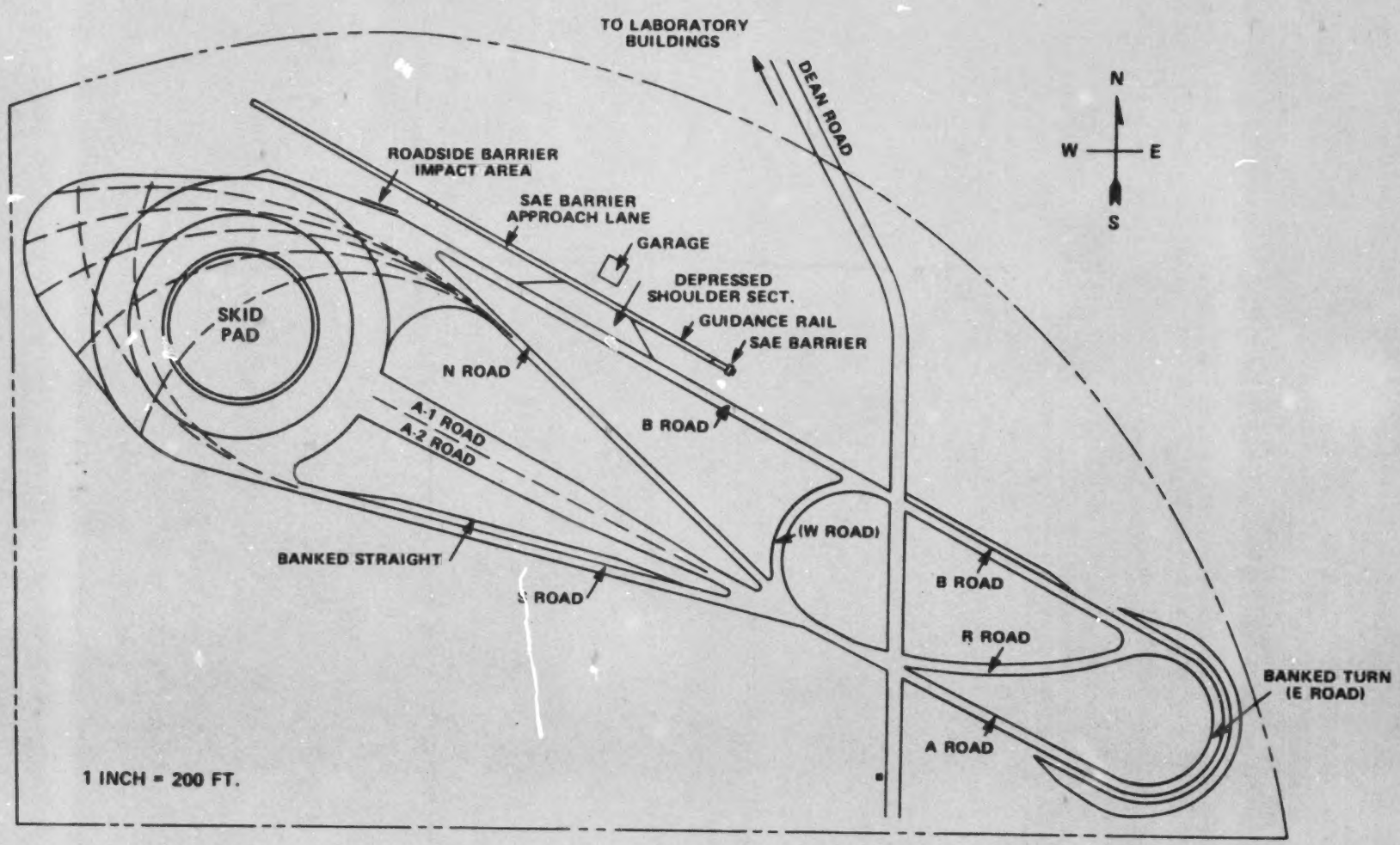
VEHICLE EXPERIMENTAL RESEARCH FACILITY (VERF)

The Vehicle Experimental Research Facility (VERF) is located adjacent to the Laboratory's main buildings at its Genesee Street address. An aerial view and a layout are shown in the following pages.

A summary of the basic elements and features are listed below.

1. Facility Cost - $750,000 approx.
   Facility Area - 33 acres

2. Basic Elements -
   - 400 foot diagonal asphalt skid pad
   - 100 foot radius banked turn
   - Four approach lanes linking skid pad and banked turn
   - Roadside barrier crash provisions, with 10° and 25° unmanned vehicle guidance
   - SAE-type impact barrier wall - 12' x 10':
     (a) Approach lane - 792 feet x 8 feet wide with guide rail
     (b) Powered winch-towing system - 6000 lb vehicle, maximum speed 75 mph, 25,000 lb vehicle, maximum speed 60 mph
     (c) Abort system - automatically aborts vehicle if desired speed is not reached
     (d) Photo-pit at barrier face and overhead photo stand
     (e) Photo-pit at mid-lane (car-to-car impacts)
     (f) Photo Tower - portable for full coverage of car-to-car and road barrier tests.



CORNELL AERONAUTICAL LABORATORY VEHICLE EXPERIMENTAL RESEARCH FACILITY (VERF)

IMPACT SLED TEST FACILITY

Cornell Aeronautical Laboratory's high-capacity, impact sled accelerator can provide an indoor, controlled, repeatable, simulated vehicle crash environment for the evaluation of full scale vehicle structures and occupant protection systems and the validation of analytical models. Typical characteristics and capabilities are listed below.

- Building and equipment cost — $300,000 approx.
- Building area — 5,300 sq ft
- Rail-operating length — 94 feet
- Carriage size (test bed) — 4' x 12'
- Capabilities:

Payload	"G" Max	Velocity mph
2000	48	75
3000	40	69
4000 (full size car)	35	64

- A wide variety of acceleration pulse shapes can be produced (six metering pins available).
- High speed camera capabilities - 2,000 feet/second.
- Test dummies available - child (3 years old or 6 years old), various male and female body sizes.

The impact machine is unique in that the test vehicle or component is subjected to an equivalent acceleration pulse rather than a deceleration stopping pulse during a crash. Maximum flexibility is provided by controlling the shape and duration of the acceleration pulse over wide limits. Test vehicles and components can be mounted on the impact machine at any angle or position to simulate virtually any impact condition. It is obvious that the dynamics of an automobile and its occupants during an accident are extremely complex. It is therefore important to closely simulate actual accidents. [The Impact Sled's measured repeatability has been better than 3% for typical test programs.]

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APPENDIX III

SELECTIVE BRAKING SYSTEM VEHICLE

SELECTIVE BRAKING SYSTEM VEHICLE

The test vehicle has been fitted with a selective braking system as shown on the attached schematic. It is possible with this system to deactivate the brake wheel-cylinder or any combination of wheels by presetting the needle valves on the manifold block and activating the solenoid valve. The arrangement is such that the brakes can be completely normal until the solenoid valve is operated at which time the preselected wheels are blocked off. A light on top of the instrument panel glows when the solenoid valve is closed, indicating that the vehicle brakes are abnormal; that is, in test configuration.

If the system is properly used, so that the two needle valves corresponding to the same wheel are never closed at the same time, the brakes are fully serviceable with the solenoid valve de-energized. In the interests of safety, however, it is essential that at the conclusion of every test, and before the vehicle is removed from the test area that all needle valves are moved to the full open position. The valve handles on the "manual bank" have been drilled and a safety wire is to be passed through the handles to guarantee their position.

Operation

It is recommended that any person using this car first check the manifold to assure himself of valve position. The car should be placarded as a reminder that the brakes are modified.

Brief instructions on the operation of the system follows (see sketch and photo).

For each wheel that is to be deactivated:

1. Close valve on "manual bank" corresponding to that wheel.
2. Confirm that all remaining valves on "manual bank" are open.
3. Confirm that valves corresponding to deactivated wheels on "auto-bank" are open.
4. Close all remaining valves on "auto-bank."
5. Operate solenoid valve as required.
6. Apply service brakes.

Example: to lock LF & RR wheels, deactivate RF & LR.

1. Close RF & LR on "manual bank."
2. Open LF 7 RR on "manual bank."
3. Close LF & RR on "auto bank."
4. Open RF & LR on "auto bank."
5. Closing solenoid valve will now block RF & LR, permitting only the LF & RR wheel cylinders to operate when service brakes are applied.

To fail front wheels:

1. Close RF and LF on "manual bank."
2. Open RF and LF on "auto-bank."
3. Open LF

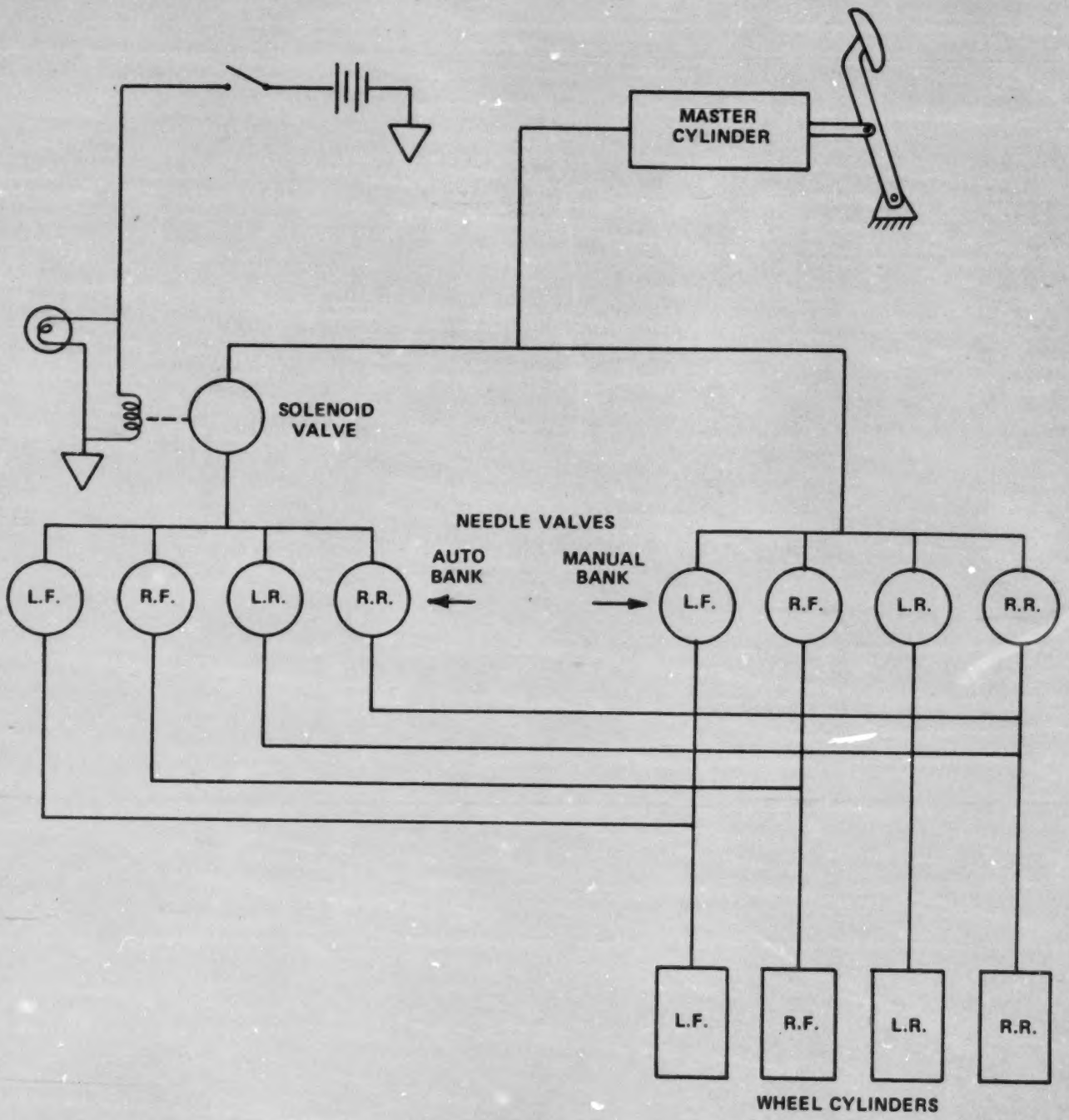

Figure 1 Figure III-1

APPENDIX IV

INSTRUCTION STAFF AND ATTENDEES:

SESSIONS I, II, III

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November 30-December 18, 1970

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SESSION II: February 8 - 26, 1971

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COLLISION INVESTIGATION TRAINING PROGRAM

Second Session: February 8-26, 1971

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COLLISION INVESTIGATION TRAINING PROGRAM

Third Session: April 12-30, 1971

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APPENDIX V

STUDENT'S CLASS CRITIQUE

COLLISION INVESTIGATION TRAINING PROGRAM

Student's Class Critique

We solicit your assistance in upgrading course and lesson material, and its presentation. You can cooperate by letting us know your thoughts and comments on each lesson of the day.

A list of the courses will be provided each day. Please comment on each session. The following questions are of particular interest.

- Was lesson content pertinent to general objectives of the course?
- Was lesson adequate to cover subject area intended?
- Were objectives of lesson achieved?
- Was time allotted sufficient?
- Was instructor adequate?
- Were visual aids adequate?
- Was class exercise needed?
- Were handouts needed?
- Additional comments.

Thank you.

STUDENTS' CRITIQUES - Third Session

Monday, April 12

TOUR OF CAL FACILITIES

Very good, would like to have seen some equipment in operation.

Information concerning some of the more informative or spectacular staged accidents, with the damaged vehicles that are available, would have helped the tour.

The tour was very informative and could possibly be extended to see more research projects.

Interesting.

OUR HIGHWAY TRANSPORTATION SYSTEM, and MULTI-DISCIPLINARY TEAM INVESTIGATIONS - GENERAL

Good presentation of inter-related systems.

Satisfactory.

A little lengthy, or too thorough.

More intermediate slides showing actual examples or cases to illustrate points (first part of presentation). Lesson content adequate.

Very good presentation - very easy to follow (MD Teams).

Instructor, excellent.

ACCIDENT INVESTIGATION: STATE OF THE ART

Interesting but long. Some visual aids would be a great assist.

Satisfactory.

Too much history - recent State of the Art would have been more interesting.

See "Comments".

Handouts would be an asset for individual's use at a later date and save hours of research. The dates of different phases of the art would be valuable. (NOTE: Information is contained in handout: Proceedings of Collision Investigation Methodology Symposium.)

Interesting - instructor very good.

MECHANICS OF FIELD DATA COLLECTION - RELATIONS WITH OTHER AGENCIES

Good explanation of ACIR program and methods of set-up. Also tri-level.

All aspects well done.

Satisfactory.

Slides of people sitting around tables didn't seem pertinent; a little choppy.

Instructor excellent.

NHTSA APPROACH TO ACCIDENT INVESTIGATION

Satisfactory.

Good.

All aspects well done.

Good presentation of NHTSA approaches to accident investigation.

Good presentation but he followed the slides rather than the slides fitting into a lecture. Too many examples.

Instructor very good.

GENERAL COMMENTS

Good program. However, holding class until 5:30 is too long. Is it possible to organize program to have some class work and some field work each day?

Lectures tended to be boring, especially the "state of the art" in which too many names and dates were given and insufficient interesting points stated. A little humour if available would help too.

The visual aid system is extremely well organized.

All speakers are very knowledgeable in their field of expertise.

Answers to all the questions on the Class Critique Questionnaire -- Yes. With the exception class exercise not necessary at this time.

Answers to Class Critique questions: Yes.

Tuesday, April 13

COLLECTION, PRESERVATION AND INTERPRETATION OF PHYSICAL EVIDENCE

Good.

Very good presentation of physical evidence at scene and skidmarks.

Skidmarks excellent.

Should have mentioned his definitions were in the notebook. Following notes made lecture clearer. Diagramatic handouts would have been easier.

Useful information - well presented.

Excellent presentation of skidmarks. The slides of examples of different types of marks were good. It would be well to distribute pictures for students to keep, illustrating the various marks.

Interesting, instructor excellent.

ENVIRONMENT - CAUSATIVE FACTORS

Good.

Good speaker - informative presentation of highway.

Good.

Very clear - good presentation.

Useful information - well presented.

Could have used a little handout material on the environment lecture.

Interesting, instructor excellent.

THE VEHICLE

Not very relevant to what we're doing here. Most everyone knows this nomenclature.

Good.

Believe Mr. talk on automotive anatomy could be aided and shortened with a handout of his slide material.

Good.

Well structured. Good slides.

All useful, but 1st session involved much detail which became monotonous. 2nd session more safety oriented and much more interesting. A handout showing current terms for vehicle parts would be useful.

Instructor good.

USE OF HIGHWAY SAFETY MATRIX

Good.

Good explanation of matrix - needed.

Good.

Very organized. Slides fit in very well.

Good presentation - thorough.

Instructor good.

The subject "Use of highway safety matrix" was a rather dry subject (thru I feel no fault of the instructor). However, I can see that said subject is necessary to give one an insight into the research going on.

GENERAL COMMENTS:

Good program - However holding class until 5:30 is too long. Is it possible to organize program to have some class work and some field work each day?

Since trucks are a fair part of the vehicle population, and certainly accident vehicles -- suggest they be covered in some similar way as auto anatomy.

Lectures interesting. Handouts should be provided with an index to facilitate the use of these handouts.

The visual aids used in conjunction with the speaker are excellent.

Answers to all questions on the Class Critique Questionnaire -- Yes. With exception, class exercise not necessary at this time.

Answers to Class Critique questions: Yes.

Wednesday, April 14

INTERVIEWING AS COMMUNICATION

Interviewing as Communication lecture for interesting and Dr. for good speaker keeping class well interested.

Should have passed out social reliability scale. The NHTSA has a review of Kahn and Cannell by Dr. Why wasn't it handed out? Should have been more structured. Student participation was good. Ethnic examples are in poor taste.

Very good.

The discussion associated with Mr. presentation was very interesting. The discussion generated showed the extreme interest by the class.

Fine.

Believe Dr. remarks were very relevant and well presented -- however they might better be related more in the context of what specifically should be solicited, and expected in responses, as well as the mechanics of an interview as required of the MDAI team.

I especially enjoyed the lesson given by Dr. and found him to be a most interesting and informative instructor.

Very interesting, instructor excellent.

INTRODUCTION TO INTERVIEWING METHODS

Fine.

The tape presented by Mr. was also interesting and helped prepare one for the events to come.

Very good, taped interview listening. Instructor excellent, but not enough time alotted.

Wednesday, April 14

THE PSYCHOLOGICAL AUTOPSY

Very good and important. It was nice to have some discussion.

Good background of psychological questioning. Could have been more polished. Good discussion afterward.

Mr. psychological autopsy approach, upon examining the questionnaire sheets, seems fraught with too many judgements and subjective conclusions. Question the validity of the ratings used, and how arrived at.

The psychological autopsy tended to be slightly boring.

The idea expressed by Mr. was very interesting and will probably become part of the research needs in the future for those having sufficient funding.

Instructor good, but do not believe the subject matter covered pertains to my line of work and would be an added burden to Police duty.

GENERAL COMMENTS

Some people complain about being in class all day. Maybe some of the afternoons (1 or 2) each week could have been spent in the field rather than having all of the field work together at the end.

Answers to Class Critique questions: Yes.

Answers to all questions on the Class Critique Questionnaire -- Yes. With two exceptions, not enough time allotted for taped interview listening and class exercise not necessary at this time.

Thursday, April 15

BASIC ANATOMY, INJURY TYPES AND CAUSES

Instructor excellent, also subject interesting.

OCCUPANT KINEMATICS, INJURY, AMA INJURY INDEX

Interesting, instructor excellent.

GENERAL COMMENTS

Answers to all the questions on the Class Critique Questionnaire -- Yes. With exception, class exercise not necessary at this time.

The entire day was most interesting to me. Class Critique questions: Yes.

Friday, April 16

BASIC ANATOMY, INJURY TYPES AND CAUSES, Cont.

Instructor excellent.

Fine.

SKIDMARK MEASUREMENTS AND RECORDS

Very interesting, instructor excellent.

Fine.

COMPONENTS OF COMPLETED CASE REPORT

For the teams you should have used the DOT's required case summary and case content forms.

Subject very interesting, instructor excellent.

INTRODUCTION TO VEHICLE DAMAGE INDEX

Good presentation.

Very interesting, instructor excellent.

Fine.

It was explained thoroughly and the student practice on the subject was extensive.

Friday, April 16, cont.

GENERAL COMMENTS

CAL instructors and impressed me as being very proficient in their particular fields and I felt this to be true throughout the course.

Answers to Class Critique questions: Yes.

Answers to all the questions on the Class Critique Questionnaire -- Yes. With exception, class exercise not necessary at this time.

Monday, April 19

PHOTOGRAPHY AND USE OF CAMERA

I personally feel the photography part is very important especially to personnel who have not used cameras regularly.

Camera and photo techniques good and well presented. Could benefit more from groups of slides for typical and specific accident cases as well as the general coverage comments.

Subject very interesting, instructor excellent.

I feel in the photography field practice session that it may be more helpful to the students if the class could be broken down into small groups and each group provided with a vehicle and sufficient space to work around it, rather than the entire class concentrating on one or two vehicles.

FIELD EQUIPMENT

The list of field equipment to be supplied will definitely be an asset.

POSTMORTEM STUDIES

Dr. postmortem studies presented primarily as a "horror show" and certainly could have been better organized.

The Postmortem Studies discussed by Dr. were presented very well.

GENERAL COMMENTS

Answers to all questions on the Class Critique Questionnaire -- Yes.
Answers to Class Critique questions: Yes.

Tuesday, April 20

TRUCK EVALUATION

Subject interesting, instructor good.

Mr. presentation: too much emphasis on driver regulations and DOT-BMCS organization, which is interesting but not too relevant to the interests of the audience.

It seems that Mr. was not well prepared for the presentation. He spent too much time discussing truck driver's qualifications and records rather than truck accidents.

Truck evaluation was not good for our purposes.

I found the lesson on "Truck evaluation" to be somewhat dry (thru no fault of the instructor) but I do feel said lesson is pertinent to general course objectives.

VEHICLE EVALUATION

Vehicle evaluation was excellent both in the manner of presentation and the content. Handouts of some or all of the charts showing the alteration of handling could be of use in the future.

The slides presented by Mr. were too small to see them. Some material about his subject would be helpful. It was difficult to keep notes with the lights out most of the time.

Subject very interesting, instructor excellent.

GENERAL COMMENTS:

Answers to all the questions on the Class Critique Questionnaire -- Yes. With exception, class exercise not necessary at this time.

Answers to Class Critique questions: Yes.

Wednesday, April 21

VEHICLE DATA, cont.

Valuable lesson.
Instructor excellent.

COMPLETING GM FORM

Good practice.

review of GM Long Form well done and very helpful.

Very interesting, instructor excellent.

COMPLETING GM FORM - FIELD EXERCISE

Suggest a little better organization of activities during outdoor exercise.

GENERAL COMMENTS

This was the evening I went out with the on scene investigation team. The two investigators and were most congenial and made every attempt to explain to us and show us their procedures. For myself an experienced police officer it was an education in itself to see research investigators operate in the field.

Answers to all the questions on the Class Critique Questionnaire -- Yes.

Answers to Class Critique questions: Yes.

Thursday, April 22

SPEED ESTIMATING, PART I

Speed Estimation could be helped by a more orderly presentation of material -- while many words were given, I do believe that the mechanics of estimating speed left us all unsure of ourselves.

Very interesting, instructor excellent.

Lesson Re. speed estimates was not adequate for myself as to the mathematical background and formulas. However I feel I may well be the exception to the rule having a poor grasp of math. Eventually thru the use of the charts provided and the help of I was able to grasp the concept of it and work out problems on the charts.

VEHICLE DAMAGE INDEX

It was explained thoroughly and the student practice on the subject was extensive.

MAKING SKID AND BRAKE TESTS

I enjoyed the field exercises on the skid pad very much and feel they helped a great deal in applying the knowledge gained in the class room.

GENERAL COMMENTS:

Answers to Critique questions: Yes.

Answers to all questions on the Class Critique Questionnaire -- Yes.

Friday, April 23

PEDESTRIAN KINEMATICS

Interesting, instructor excellent.

MEASURING AND RECORDING SKIDMARK EVIDENCE (COMPLETE FIELD EXERCISE

I enjoyed the field exercises on the skid pad very much and feel they helped a great deal in applying the knowledge gained in the classroom.

OCCUPANT KINEMATICS

It was very well presented, even though portion of it was discussed one week, and the subject was completed later.

GENERAL COMMENTS:

Answers to all the questions on the Class Critique Questionnaire -- Yes.

Answers to Class Critique Questions: Yes.

Monday, April 26

VEHICLE DAMAGE INDEX

Believe that VDI discussion dwelled a little more on the subtleties of interpretation rather than an actual use. Various basic and common examples would have helped. (They were given later. Perhaps they - examples - should have been given, or stressed, first.)

Subject interesting, instructor excellent.

DEVELOPMENT OF ACCIDENT INVESTIGATION AID

Computer-aided transit scene measurement and analog vehicle dynamics simulation interesting, but not too relevant to purpose of the course. Could help to "play-down" and better use the time for more common investigation techniques.

Subject interesting, instructor good.

TEAM INTERACTIONS

Mr. overview of people and the how of investigating very good and valuable.

Subject very interesting, instructor excellent.

METALLURGY AS AN INVESTIGATIVE AID

Mr. metallurgy completely over everyone - had better spend time in discussing "what is" metallurgy and what it could "do" for you.

Instructor excellent.

Tuesday, April 27

VEHICLE HANDLING 1

Primarily an oral final report on the steering-shocks degradation tests at CAL. Would have liked to see a little more tutorial approach in terms of basic vehicle handling characteristics and what to look for in accidents.

Subject interesting, instructor good.

VEHICLE HANDLING 2

Mr. talk interesting and philosophical, could be a little more relevant to accident causation, and vehicle characteristics associated therewith.

Subject interesting, instructor very good.

VEHICLE DAMAGE INDEX

VDI could be discussed a bit better with more examples, (perhaps sketches and handouts) rather than emphasis of subtleties in interpretation.

Subject interesting, instructor excellent.